U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

WIND AND WATER POWER TECHNOLOGIES OFFICE

U.S. Department of Energy's Wind Program Funding in the United States:

Environmental Projects Report

Fiscal Years 2006 - 2015

Introduction

Wind and Water Power Technologies Office

The Wind and Water Power Technologies Office (WWPTO), within the U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE), supports the development, deployment, and commercialization of wind and water power technologies. WWPTO works with a variety of stakeholders to identify and support research and development (R&D) efforts that improve technology performance, lower costs, and—ultimately—deploy technologies that efficiently capture the abundant wind and water energy resources in the United States. WWPTO is one office that contains two distinct focus programs: wind and water. The Wind Program and the Water Power Program operate as integrated, but separate entities within WWPTO.

The Wind Program is committed to developing and deploying a portfolio of innovative technologies for clean, domestic power generation to support an ever-growing industry.

The Wind Program provides R&D funding across six broad areas:

1. Offshore Wind Projects
2. Testing, Manufacturing, and Component Development Projects for Utility-Scale and Distributed Wind Energy
3. Wind Integration, Transmission, and Resource Assessment and Characterization Projects
4. Environmental Projects
5. Market Acceptance Projects
6. Workforce Development Projects.

The breakdown of Wind Program funding is presented in a series of reports that showcase the projects funded in each of the six abovementioned areas.

Types of Funding Sources

WWPTO's research and development (R&D) projects are financed through two primary sources of funding: Congressional Appropriations and Congressionally Directed Projects (CDPs).

Congressional Appropriations determine the operating budgets for each EERE office. WWPTO- funded R&D projects are typically awarded to recipients as cooperative agreements through competitive Funding Opportunity Announcements (FOAs) that are dedicated to specific topic areas. CDPs are also funded by Congress, but are outside of the annual federal budget process. Frequently, there is a cost-share requirement for recipients of both competitive cooperative agreements resulting from FOAs and CDPs.

In addition to these two primary funding sources, WWPTO may be financed directly through specific legislation passed by Congress. In Fiscal Year 2009, for example, Congress passed the American Recovery and Reinvestment Act of 2009 (ARRA/ Recovery Act). A portion of Recovery Act funding was dedicated to WWPTO's R&D projects.

WWPTO also funds research projects at DOE's national laboratories through the laboratories' annual operating plans. This funding is not detailed in this report. However, a national laboratory may be a lead or a partner on a competitively awarded project covered in this report. In these cases, the national laboratory is identified as the lead or partner in the appropriate project descriptions.

The Small Business Innovation Research (SBIR) program in DOE's Office of Science provides competitive awards-based funding for domestic small businesses engaging in R&D of innovative technology. SBIR has funded several projects with relevance to wind technology development; however, these projects are not covered in this report.

Photo from NREL

Photo from Iberdrola Renewables, Inc.

Environmental Research & Siting for Wind Projects

The Wind Program works to remove barriers to wind power deployment and to increase the acceptance of wind power technologies by addressing siting and environmental issues. Wind power is a renewable, low- carbon footprint energy supply option. When properly sited, wind projects provide a net environmental benefit to the communities in which they operate and to the nation overall.

As with all energy supply options, wind energy can have adverse environmental impacts. Wind projects have the potential to reduce, fragment, or degrade habitat for wildlife, fish, and plants. Turbine blades and towers can pose a threat to flying wildlife like birds (for example, the sage-grouse) and bats. To understand how to avoid, minimize, and mitigate these impacts in a cost-effective manner, the Wind Program has been investing in peer-reviewed research for more than 15 years, primarily through collaborative partnerships with the wind industry and environmental organizations, such as the National Wind Coordinating Collaborative, the Grassland and Shrub-Steppe Species Collaborative, and the Bats and Wind Energy Cooperative. The Program also works with other federal agencies to develop guidelines that enable developers to meet the statutory, regulatory, and administrative requirements for protecting wildlife, national security, and public safety.

From 2006 to 2015, DOE's Wind Program announced awards totaling $26,969,126 for 46 projects focused on environmental impacts and siting. Table 1 provides a brief description of each of these projects.

There are two sources of funding for environmental projects covered in this report: competitive Funding Opportunity Announcements (FOAs; funded by Congressional Appropriations) and Congressionally Directed Projects (CDPs). See "Types of Funding Sources" for more information.

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
ABB, Inc.	National Offshore Wind Energy Grid Interconnection Study	$900,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	North Carolina
Project Description				
ABB assessed the likely impact of offshore wind development in the various regions of the United States from the electric utility perspective. This work included developing energy production profiles, performing an initial integration analysis, and evaluating the applicability of traditional integration study methods and potential energy collection and delivery technologies.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
AWS Truepower, LLC	National Offshore Wind Energy Resource and Design Condition Data Campaign	$900,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	New York
Project Description				
AWS Truepower is establishing a Web-based national met-ocean wind energy resource and design conditions data inventory. The project will establish data needs, identify existing sources of relevant data, and carry out a gaps analysis to establish long term requirements for new data to be gathered and disseminated through national public-private collaboration initiatives.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Bat Conservation International, Inc.	Win(d)-Win(d) Solutions for Wind Developers and Bats	$118,800	FY09: 20% Wind by 2030 FOA	Texas
Project Description				
Bat Conservation International tested the effectiveness of acoustic deterring devices to reduce bat fatalities at operating facilities.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Bat Conservation International, Inc.	Evaluating the Effectiveness of an Ultrasonic Acoustic Deterrent in Reducing Bat Fatalities at Wind Energy Facilities	$499,792	FY15: Bat Impact Minimization Technologies and Field Testing Opportunities FOA	Texas
Project Description				
Bat Conservation International will conduct reliability tests for an electronic deterrent device and carry out a full-scale validation of its effectiveness at a wind plant. The project will also compare the electronic deterrent's ability to reduce impacts to bats versus turbine curtailment—or turning turbines off when bats are most active—the primary mitigation measure currently in use.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
BioDiversity Research Institute	Modeling Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf	$4,500,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	New Jersey, Delaware, Maryland
Project Description				
BioDiversity Research Institute is collecting and analyzing data on bird, sea turtle, and marine mammal abundance and movement in the Mid-Atlantic region to determine species risk to offshore wind plant interaction. The project is performing baseline surveys using a variety of technologies to develop predictive and risk-assessment frameworks.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
BioDiversity Research Institute	Stereo-Optic High Definition Imaging: A New Technology to Understand Bird and Bat Avoidance of Wind Turbines	$1,110,074	FY14: Technology Incubator for Wind Energy Innovations FOA	Maine
Project Description				
The BioDiversity Research Institute will develop a stereo-optic camera system to detect and document bird and bat flight behavior in the vicinity of wind turbines. This system will use near-infrared cameras and specialized software to detect animal movements throughout the day and night, and will work to automate the identification of different species of birds and bats. The project will help researchers better understand potential environmental impacts of wind turbines.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Board of Trustees of the University of Illinois	Are Flying Wildlife Attracted to (or Do They Avoid) Wind Turbines?	$180,835	FY09: 20% Wind by 2030 FOA	Illinois
Project Description				
The University of Illinois provided information essential to a risk assessment framework for flying wildlife, namely determining if night-flying wildlife actively fly toward wind turbines (or away from them) from a distance, using natural post-construction observations with an instrumentation tracking radar.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Bowling Green State University	Coastal Wind Ohio	$2,531,900	FY06, FY08, FY09 CDPs	Ohio
Project Description				
Bowling Green State University conducted research to remove impediments for deployment of wind turbines in Lake Erie. The primary research questions addressed the deployment design and environmental issues.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Bowling Green State University	Coastal Ohio Wind Project: Removing Barriers to Great Lakes Offshore Wind Energy Development (OH)	$1,000,000	FY10: CDP	Ohio
Project Description				
Bowling Green State University conducted the Coastal Ohio Wind Project to address problems that impede deployment of wind turbines in the coastal and offshore regions of northern Ohio. The University conducted research to improve monitoring tools used for surveillance to better understand operational data from wind turbines and issues that relate to ice mitigation, and to understand different economic scenarios that may emerge from deployed offshore wind turbines.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Case Western Reserve University	Great Lakes Offshore Wind: Utility and Regional Integration Study	$540,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Ohio
Project Description				
Case Western University is evaluating potential impacts of offshore wind on the electric grid in the Great Lakes region and determining requirements for interconnection, control systems, and the application of additional support for different transmission systems. The project is providing regional stakeholders with the knowledge base and capabilities to develop state-of-the-art, long-range strategies for mitigating the impacts of offshore wind interconnection, as well as realizing the economic cost reductions and benefits that can be achieved through implementing these strategies.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Douglas-Westwood, LLC	Optimized Vessel Assessment for Offshore Wind in the United States	$300,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOAA	New York
Project Description				
Douglas-Westwood identified the national vessel requirements under several offshore wind industry growth scenarios. The project collected data on the vessels currently deployed in the international offshore wind industry, assessed necessary trends for future dedicated vessels, and identified resources to implement innovative strategies to support companies seeking to build new vessels and establish related services as the industry grows. The final report detailing the assessment can be accessed at http://energy.gov/eere/wind/downloads/assessment-vessel-requirements-us-offshore-wind-sector.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Duke Energy Business Services, LLC	Carolinas Offshore Wind Integration Case Study	$534,910	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	North Carolina
Project Description				
Duke Energy Business Services conducted a study that examined the potential system impacts of offshore wind development on the Duke Energy Carolinas system, determined the costs of upgrading the transmission system to support large-scale offshore projects, and assessed strategies for system integration and management. The first phase of the study—details of which can be accessed at http://www.nctpc.org/ nctpc/document/REF/2013-06-06/COWICS_Phase_1_Final_Report1[1].pdf—found that new high-voltage transmission infrastructure is needed to reliably integrate offshore wind resources.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Frontier Wind	Mounted Bat Impact Deterrence System	$249,000	FY15: Bat Impact Minimization Technologies and Field Testing Opportunities FOA	California
Project Description				
Frontier Wind will develop and test an ultrasonic acoustic deterrent system comprised of an array of electric ultrasonic transmitters mounted along the length of turbine blades. High-frequency sounds from these transmitters will cover the entire turbine rotor, potentially increasing bat deterrence.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Garrad Hassan America, Inc.	User-Friendly Analysis Tool for Optimized Offshore Wind Ports Assessment	$497,725	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	California
Project Description				
Garrad Hassan America incorporated lessons learned from Northern European offshore wind projects to identify the port requirements necessary to meet various offshore wind industry growth scenarios in the United States. The project created a publicly available analysis tool to enable decision makers to perform cost-benefit assessments of potential port infrastructure investments in support of offshore wind development.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Garrad Hassan America, Inc.	User-Friendly Analysis Tool for Optimized Offshore Wind Installation, Operation, and Maintenance Strategies	$199,100	FY11 U.S. Offshore Wind: Removing Market Barriers FOA	California
Project Description				
Garrad Hassan America identified and quantified key areas for offshore wind project installation and operations where advancements in the approach or technology may lower the cost of energy produced by offshore wind plants. The project developed a user-friendly tool that enables project developers, owners, and managers to evaluate and compare how various installation and maintenance strategies and technical approaches impact the cost of energy.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
General Electric (GE) Power & Water	Ultrasonic Bat Deterrent Technology	$525,637	FY15: Bat Impact Minimization Technologies and Field Testing Opportunities FOA	South Carolina, Ilinois
Project Description				
GE will advance the development of a turbine-integrated, air-powered deterrent device by refining their design based on lab testing and field tests at an operating wind plant.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Indiana University Trustees	An Integrated Approach to Offshore Wind Energy Assessment: Great Lakes 3D Wind Experiment	$700,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Indiana
Project Description				
Indiana University, in partnership with Case Western University, Clarkson University, and Arizona State University, is conducting a project that integrates wind data from remote sensing, aerial and satellite measurements, and meteorological towers to produce a high-resolution wind characterization of Lake Erie. The project will also analyze the effectiveness of various measurement instruments and develop best practices for each type.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Jones & Stokes Associates, Inc.	An Analytical Impact Assessment Framework for Wildlife to Inform the Siting and Permitting of Wind Energy Facilities	$92,643	FY09: 20% Wind by 2030 FOA	Oregon
Project Description				
Jones & Stokes Associates developed a scalable analytical framework for standardized assessment of long-term impacts of wind turbine operations on birds and bats.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Kansas State University	Environmental Impacts of Wind Power Development of Population Biology of Greater Prairie Chickens	$299,998	FY09: 20% Wind by 2030 FOA	Kansas
Project Description				
Kansas State University developed specific recommendations for site selection and design of wind power facilities that will minimize the impacts of wind power development on sensitive species of prairie grouse. This project used post-construction monitoring to determine the potential impacts of a 201-megawatt wind power facility on the population biology of greater prairie chickens.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Long Island Power Authority	Offshore Wind Project Study	$500,000	FY10: CDP	New York
Project Description				
Long Island Power Authority is studying the economics and feasibility of an actual Long Island-New York City offshore wind farm. Information gathered from this project will be used to provide a better understanding of where wind development could be most suitable and help protect habitats important to the environment.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Michigan State University	Bat and Avian Migration Along the Lake Michigan Coastline: A Pilot Study to Inform Wind Turbine Siting	$99,951	FY09: 20% Wind by 2030 FOA	Michigan
Project Description				
Michigan State University researched the question of whether bats follow the coast of the Lake Michigan during late summer migration. The project—details of which can be accessed at http://mnfi.anr.msu.edu/reports/2011-19%20Bat%20Migration%20Along%20the%20Lake%20Michigan%20and%20Lake%20Huron%20Coastlines.pdf — helps wind energy developers reduce negative impacts to these migratory wildlife by siting wind turbines in non-migratory areas.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
National Renewable Energy Laboratory (operated by Alliance for Sustainable Energy, LLC)	Analysis of Installation, Operation, and Maintenance Strategies to Reduce Levelized Cost of Energy	$200,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Colorado
Project Description				
The National Renewable Energy Laboratory is combining its offshore wind cost model capabilities with those of the Energy research Centre of the Netherlands, along with the operating experience of an expert industry panel, to conduct an assessment of optimized installation, operation, and maintenance strategies and technologies to estimate their relative costs and benefits for offshore wind projects in U.S. waters.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Navigant Consulting, Inc.	U.S. Offshore Wind Market and Economic Analysis, Annual Market Assessment	$514,999	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Illinois
Project Description				
Navigant Consulting issued a comprehensive assessment of the U.S. offshore wind market over a three-year period. The project provided stakeholders with updated information, data analysis, and trends on technical, regulatory, financial, economic, and workforce development drivers influencing industry growth. Details on the three annual reports can be found at http://energy.gov/eere/downloads/2014-offshore-wind-market-and-economic-analysis.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Navigant Consulting, Inc.	U.S. Offshore Wind Manufacturing and Supply Chain Development	$349,998	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Illinois
Project Description				
Navigant Consulting examined factors and strategies influencing development of a U.S. supply chain for the offshore wind industry. Through industry surveys and stakeholder forums, the project identified potential gaps in the supply chain and opportunities for manufacturers and technical services companies to contribute to the domestic content of offshore project facilities. Details of Navigant Consulting's findings can be found at http://energy.gov/eere/wind/downloads/us-offshore-wind-manufacturing-and-supply-chain-development.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Oregon State University	A Synchronized Sensor Array For Remote Monitoring of Avian and Bat Interactions with Offshore Renewable Energy Facilities	$560,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Oregon
Project Description				
Oregon State University is monitoring avian and bat interactions with offshore wind turbines using a fully integrated sensor array monitoring system with onboard custom-designed data post-processing and statistical-based software.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Pandion Systems, Inc.	A Habitat-Based Wind-Wildlife Risk Tool with Application to the Upper Great Plains Region: Collisions and Habitat Displacement	$294,491	FY09: 20% Wind by 2030 FOA	North Dakota, South Dakota
Project Description				
Pandion Systems developed a spatial tool that characterizes risk for bird and bat species that are potentially susceptible to collisions with wind turbines and habitat displacement from wind farms based on the species' habitat characteristics.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Savannah River National Laboratory (operated by Savannah River Nuclear Solutions, LLC)	Advanced Technology for Improving the Design Basis of Offshore Wind Energy Systems	$554,845	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	South Carolina
Project Description				
Savannah River National Laboratory is developing new techniques for characterizing steep and breaking waves and resulting structural loads on monopile foundations.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Stantec Consulting Services, Inc.	Deepwater Offshore Bat and Avian Monitoring Program	$599,501	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Maine
Project Description				
To diminish potential impacts of offshore wind energy development on local bat populations in the Gulf of Maine, the Great Lakes, and the Mid-Atlantic coastal state regions, Stantec Consulting Services is observing patterns in offshore bat activity and species composition. To date, Stantec has monitored acoustic bat activity at 36 sites distributed across the three regions. The firm has also deployed bat detectors on a variety of lighthouses, offshore towers, weather buoys, and three research vessels from the National Oceanic and Atmospheric Administration.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Stevens Institute of Technology	Field Evaluation and Validation of Remote Wind Sensing Technologies: Shore-Based and Buoy-Mounted LIDAR Systems	$702,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	New Jersey
Project Description				
Stevens Institute of Technology is systematically evaluating the capability of scanning and vertically profiling LIDAR to accurately mea- sure the three-dimensional wind field, in comparison to fixed meteorological towers. The project will also quantify variability in offshore winds off the coast of New Jersey.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Texas Christian University	Texturizing Wind Turbine Towers to Reduce Bat Mortality	$249,076	FY15: Bat Impact Minimization Technologies and Field Testing Opportunities FOA	Texas
Project Description				
Texas Christian University will develop and test coatings that alter the surface texture of wind turbines to potentially deter bats from approaching them.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Texas Tech University	Density and Occupancy Patterns of Grassland Birds in the Competitive Renewable Energy Zones of the Texas Panhandle	$223,223	FY09: 20% Wind by 2030 FOA	Texas
Project Description				
Texas Tech University identified, evaluated, and developed mitigation strategies to reduce potential negative impacts on grassland bird species at wind resource areas. By identifying important habitats to grassland birds, this project was able to provide wind energy developers with needed information for environmentally responsible siting decisions.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Texas Tech University	Assessment of Lesser Prairie Chicken Population Distribution in Relation to Potential Wind Energy Developments	$257,984	FY09: 20% Wind by 2030 FOA	Texas
Project Description				
Texas Tech University surveyed approximately 30 percent of the lesser prairie-chicken range in the Texas Panhandle using helicopter aerial surveys that were developed at Texas Tech University. Spatial modeling will be used to determine the relationship between lesser prairie chicken lek density, habitat composition, and anthropogenic disturbance to predict the distribution of leks in the Panhandle.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Texas Tech University	The Incubation of Next-Generation Radar Technologies to Lower the Cost of Wind Energy	$1,389,900	FY14: Technology Incubator for Wind Energy Innovations FOA	Texas
Project Description				
Texas Tech University will develop a first-of-its-kind, radar-based prototype to measure the flow of wind through wind farms, which will increase data availability and lead to improved modeling. While radar platforms have been used extensively in meteorological applications, this will be the first radar system specifically designed for wind energy research. This new design for a modular and portable system will require less power to operate and be able to measure larger areas than currently utilized conventional radar systems. The project complements the Energy Department's ongoing Atmosphere to Electrons (A2e) Initiative, which aims to improve wind plant performance by increasing understanding of how wind moves throughout wind farms.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
The Nature Conservancy	Energy by Design: Science-Based Wind Energy Siting to Avoid Environmental Impacts in the Continental United States	$95,210	FY09: 20% Wind by 2030 FOA	Virginia, Wyoming
Project Description				
The Nature Conservancy's Energy by Design Project has ensured the long-term persistence of key species and habitats, while allowing for the energy production and transmission that is critical to our nation's economy, security, and carbon emission reductions.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
The Research Foundation of the State University of New York (led by Stony Brook University)	Improving Atmospheric Models for Offshore Wind Resource Mapping and Prediction Using LIDAR, Aircraft, and In-Ocean Observations	$675,219	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	New York
Project Description				
The State University of New York is verifying instrumentation and developing an improved understanding of modeling and boundary layer physics through intensive data collection around the Cape Wind site. The improved modeling will be applied to constructing more accurate wind resource maps for the East Coast of the United States.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University Corporation for Atmospheric Research	Impacts of Stratification and Non-Equilibrium Winds and Waves on Hub-Height Winds	$702,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Colorado
Project Description				
The University Corporation for Atmospheric Research is evaluating surface-level to hub-height-level wind speed extrapolations and methods in an effort to evaluate and improve the siting and design of turbines, as well as the accuracy of wind energy predictions.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University Corporation for Atmospheric Research	Investigating Marine Boundary Layer Parameterizations by Combining Observations with Models via State Estimation	$702,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Colorado
Project Description				
The University Corporation for Atmospheric Research is examining the layer of the atmosphere that has direct contact with the ocean (marine boundary layer) to determine how temperature changes in the atmosphere can affect the ocean, and how temperature changes in the ocean can affect the atmosphere conditions impacting wind energy production and facility design parameters				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University of Delaware	Mid-Atlantic Offshore Wind Interconnection and Transmission	$540,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Delaware
Project Description				
The University of Delaware is examining potential effects of wind penetration on the Mid-Atlantic electric grid and facilitating grid operations planning by identifying necessary system upgrades and grid management strategies to ensure reliable and efficient operation of the electric system.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University of Massachusetts, Amherst	A Biometric Ultrasonic Whistle for Use as a Bat Deterrent on Wind Turbines	$249,684	FY15: Bat Impact Minimization Technologies and Field Testing Opportunities FOA	Massachusetts
Project Description				
The University of Massachusetts, Amherst, will develop a blade-mounted ultrasonic whistle. As air flows over the wind turbine blade, the device will produce a deterrence signal. The project will address the challenge of deterring bats across the entire wind turbine rotor and test whether a pulsed-noise, similar to a bat call, can act as an effective deterrent.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University of Michigan	Development of a GIS-Based Decision Support Tool for Evaluating Wind Farm Sitings in Great Lakes Aquatic Habitats	$100,000	FY09: 20% Wind by 2030 FOA	Michigan
Project Description				
The University of Michigan developed a GIS-based decision support tool to support wind farm turbine siting. The tool allows resource managers to compare areas of Great Lakes bottomland to determine their relative suitability for lakbed alteration projects. The tool allows users to visualize a large number of political, cultural, biological, and physical features simultaneously.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University of Michigan, Board of Regents	Measurement and Analysis of Extreme Wave and Ice Actions in the Great Lakes for Offshore Wind Platform Design	$692,782	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Michigan
Project Description				
The University of Michigan is evaluating the conditions and processes for development of freshwater ice in the Great Lakes and its resulting impact on offshore wind energy support structures. The project will evaluate the seasonal and decade-long trends in historical icing data through field measurements and by evaluating extreme loading due to combined wind, wave, and icing effects.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
University of Texas-Austin	Assessment of Offshore Wind Farm Effects on Sea Surface, Subsurface, and Airborne Electronic Systems	$500,000	FY11: U.S. Offshore Wind: Removing Market Barriers FOA	Texas
Project Description				
The University of Texas-Austin assessed the potential of offshore wind farms to cause electromagnetic or acoustic interference of electronic detection, communication, and navigation equipment operating in the marine environment. The project interacted closely with commercial and governmental stakeholders to identify concerns and recommend mitigation methods when required.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Versar, Inc.	Spatially-Explicit Bat Habitat Screening Tool for Turbine Siting	$142,916	FY09: 20% Wind by 2030 FOA	Virginia
Project Description				
Versar conceptualized, developed, and implemented the initial design of a spatially explicit site-screening tool focused on evaluating the potential for bat mortality from collisions with wind turbines. The tool provides developers with the capability to screen potential sites early in the development process to determine how turbines and turbine layouts might interact with local bat populations.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
West Virginia University Research Corporation	Developing High-Resolution Spatial Data of Migration Corridors for Avian Species of Concern Regions of High Potential Wind Development	$193,000	FY09: 20% Wind by 2030 FOA	West Virginia
Project Description				
West Virginia University used a GPS similar to that found in a smartphone to track and characterize flight movements of golden eagles as they migrated through the Appalachian Mountains. Based on its research and analysis, the university developed a risk model that predicts behavior of golden eagles. The GPS techniques and risk model pioneered in this study are now being used to characterize the potential risks of planned wind facilities on golden eagles in turbine siting decisions, mitigating impacts on migrating golden eagles while maintaining wind power growth in areas important for development.				

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Western EcoSystems Technology, Inc.	Greater Sage-Grouse Telemetry Study for the Simpson Ridge Wind Resource Area Carbon County, Wyoming	$100,000	FY09: 20% Wind by 2030 FOA	Wyoming
Project Description				
Western EcoSystems Technology obtained reference data on demographic parameters—survival, nest success, and brood success—from three concurrent sage-grouse telemetry studies being conducted in the general area.				

continued >

Table 1: FY 2006 – FY 2015 Environmental Project Descriptions

Project Recipient	Project Title	DOE Funding Amount	Funding Source	Project Location
Western Michigan University	Genetic Approaches to Understanding the Population-Level Impact of Wind Energy Development on Migratory Bats	$99,933	FY09: 20% Wind by 2030 FOA	Michigan
Project Description				
Using existing tissue samples taken from wild-captured and turbine-killed individuals from across their range, Western Michigan University provided the best possible estimates of the eastern red bats. This project examined the influence of molecular markers and the number of individual bats sampled to detect demographic trends and the patterns of male-biased mortality.				

Environmental Funding Distribution

DOE funded 46 environmental projects through the Wind Program from Fiscal Year (FY) 2006 to FY 2015. These projects are categorized in the following sections by topic area, geographic region and division, state, recipient type, and funding source.

Funding by Topic Area

The Wind Program's environmental efforts between FY 2006 and FY 2015 fall under eight topic areas: Environmental Risk Reduction,

Resource Characterization and Design Conditions, Environmental Impact, Transmission Planning and Interconnection Studies, Optimized Infrastructure and Operations, Impact on Electronic Equipment in the Marine Environment, Offshore Wind Market and Economic Analysis, and Manufacturing and Supply Chain Development. Projects in these topic areas support the continued growth of the U.S. wind industry by providing a net environmental benefit to the communities in which they operate and to the nation overall.

Over one-third of the Wind Program's environmental funding went to Environmental Risk Reduction projects, while Resource Characterization and Design Conditions projects accounted for over one-quarter of total funding. Table 2 provides details on the environmental projects within the eight topic areas.

Table 2: FY 2006 – FY 2015 Environmental Funding Distribution by Topic Area

Topic Area	Total Funding	Percent of Total
Environmental Risk Reduction	$10,042,764	37%
Resource Characterization and Design Conditions	$7,018,746	26%
Environmental Impact	$4,830,884	18%
Transmission Planning and Interconnection Studies	$2,514,910	9%
Optimized Infrastructure and Operations	$1,196,825	4%
Impact on Electronic Equipment in the Marine Environment	$500,000	2%
Offshore Wind Market and Economic Analysis	$514,999	2%
Manufacturing and Supply Chain Development	$349,998	1%
Total	$26,969,126	

Funding by Geographic Region & Division

Environmental project funding was awarded in each of the nation's four geographic regions, with the Midwest region receiving the largest share of funding due to FOA and CDP funding for projects in Illinois, Michigan, and Ohio. The remaining funding was distributed to the West, South, and Northeast, with the West receiving a smaller amount.

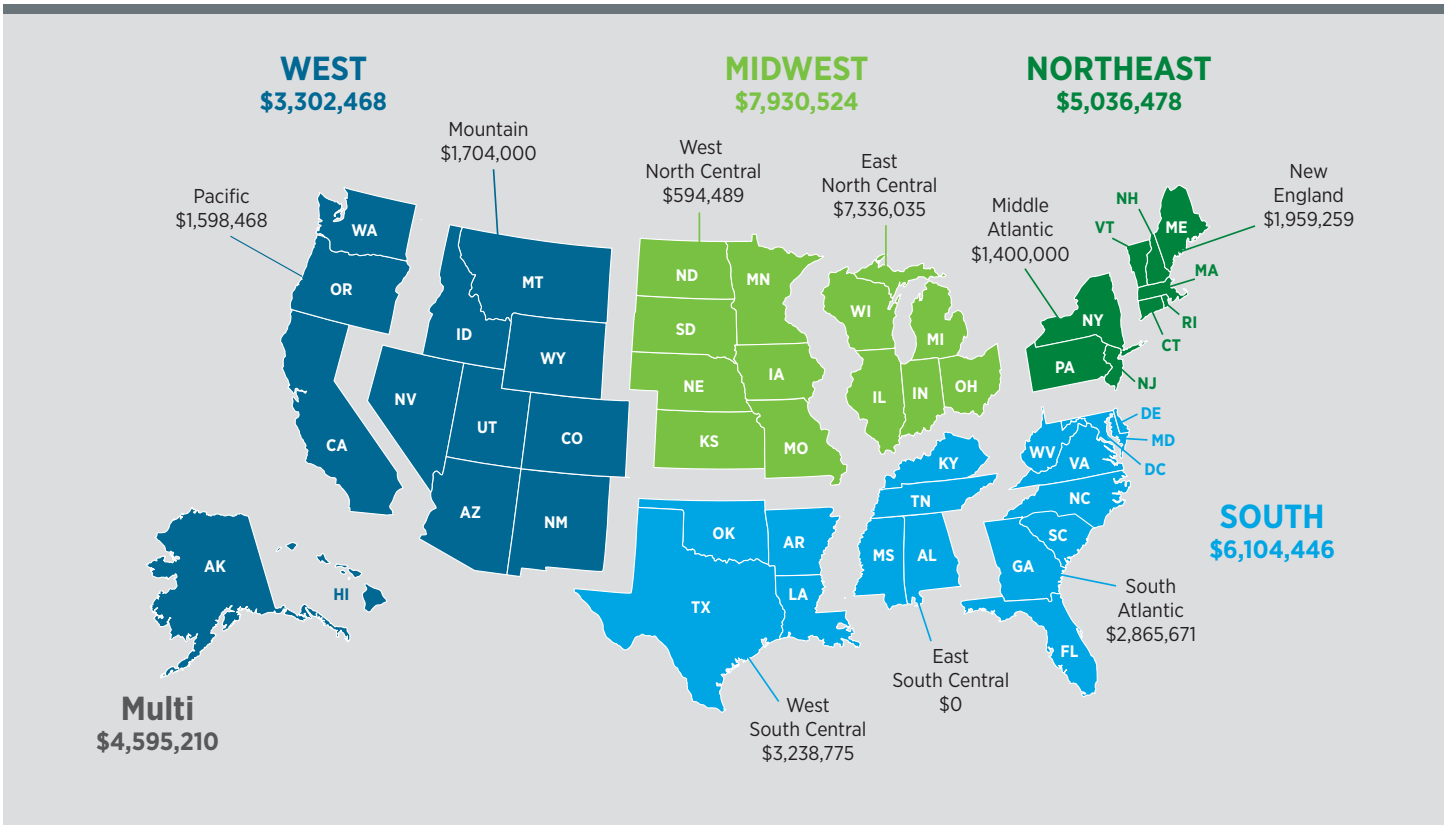
Table 3 provides details on how the Wind Program's funding was distributed within regions and divisions. The geographic regions and divisions used to present the distribution of the Wind Program's funding are based on the U.S. Census Regions and Divisions.1

Exhibit 1 provides a map that shows how the Wind Program's funding for these projects was distributed throughout the United States.

Table 3: FY 2006 – FY 2015 Environmental Funding by Geographic Region & Division

Region	Region Total Funding	Division	Division Total Funding
West	$3,302,468	Mountain	$1,704,000
		Pacific	$1,598,468
South	$6,104,446	South Atlantic	$2,865,671
		West South Central	$3,238,775
		East South Central	$0
Northeast	$5,036,478	Middle Atlantic	$3,077,219
		New England	$1,959,259
Midwest	$7,930,524	East North Central	$7,336,035
		West North Central	$594,489
		Multi	$4,595,210
		Total	**$26,969,126**

Exhibit 1: FY 2006 – FY 2015 Environmental Funding by Geographic Region & Division



Funding by State

Wind Program funding for the 46 environmental projects was broadly distributed to organizations in 19 states, with 3 projects listed as multistate. Table 4 outlines funding by state.

The states with the largest individual share of funding were Ohio and Texas, receiving a combined total of more than $7 million (or more than 25% of the total funding), while the three multistate projects received 18% of the funding for this portfolio.

Table 4: FY 2006 – FY 2015 Environmental Funding Distribution by State

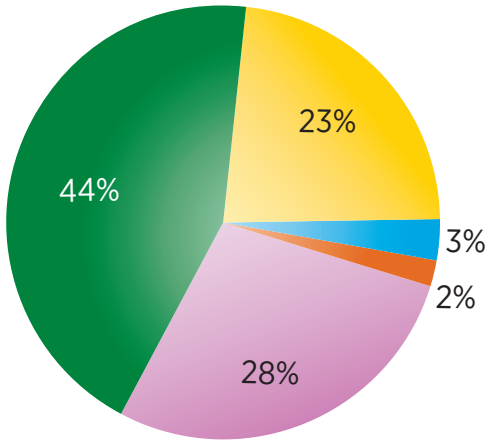
State	Total Funding
California	$945,825
Colorado	$1,604,000
Delaware	$540,000
Illinois	$1,571,469
Indiana	$700,000
Kansas	$299,998
Maine	$1,709,575
Massachusetts	$249,684
Michigan	$992,666
New Jersey	$702,000
New York	$2,375,219
North Carolina	$1,434,910
Ohio	$4,071,900
Oregon	$652,643
South Carolina	$554,845
Texas	$3,238,775
Virginia	$142,916
West Virginia	$193,000
Wyoming	$100,000
Multi	$4,889,701
Total	**$26,969,126**

Funding by Recipient Type

DOE funds a variety of recipient types, including private industry, nonprofit organizations, universities and community colleges, investor-owned utilities and public utilities, local and state governments, as well as DOE national laboratories, federal agencies, and interstate government agencies.

From FY 2006 to FY 2015, universities or colleges accounted for more than one third of the total environmental funding. The remaining funds were distributed to non-profit private industry, public utilities, and national laboratories. Exhibit 2 provides these details by recipient type.

Exhibit 2: FY 2006 – FY 2015 Workforce Development Funding Distribution by Recipient Type



University / College
$11,785,485

Non-Profit
$7,609,076

Private Industry
$6,319,720

National Laboratory
$754,845

Public Utility
$500,000

Total funding: $26,969,126

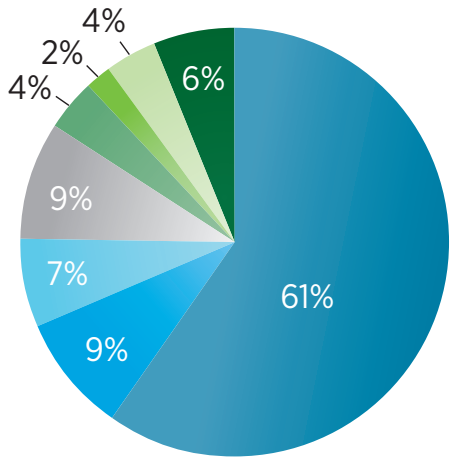
Project funds awarded to universities and colleges dominate the Program's testing, manufacturing, and component development funding portfolio, representing 44%—or more than $11 million—of total funding.

Funding Sources

Exhibit 3 below provides details on the sources of funding for the Wind Program's 46 environmental projects awarded from FY 2006 to FY 2015.

Between FY 2006 to FY 2015, the Wind Program issued numerous competitive FOAs; four of these FOAs are represented in this report, receiving approximately $23 million of the total funding for 43 projects. An additional $4 million was awarded to three projects through CDP funds.

Exhibit 3: FY 2006 – FY 2015 Environmental Projects



Total funding: $26,969,126 | Total number of projects: 46

FOA 78%

- **FY11: U.S. Offshore Wind: Removing Market Barriers FOA**
  $16,365,079
  Number of Projects: 22
- **FY09: 20% Wind by 2030 FOA**
  $2,298,984
  Number of Projects: 14
- **FY15: Bat Impact Minimization Technologies and Field Testing Opportunities FOA**
  $1,773,189
  Number of Projects: 5
- **FY14: Technology Incubator for Wind Energy Innovations FOA**
  $2,499,974
  Number of Projects: 2

CDP 15%

- **FY10: CDP**
  $1,500,000
  Number of Projects: 2
- **FY09: CDP**
  $951,500
  Number of Projects: *1
- **FY08: CDP**
  $590,400
  Number of Projects: *1
- **FY06: CDP**
  $990,000
  Number of Projects: *1

*The number of distinct environmental CDP projects is three; some projects were funded as CDPs in multiple years (see Table 1)."

Accomplishments

The Wind Program provided nearly $27 million in funding for 46 environmental projects from FY 2006 to FY 2015, with numerous projects operating over multiple years. The Wind Program has already realized significant return on the federal investment to date and anticipates significant key accomplishments in the years to come.

A few of the Program's project accomplishments include the following:

- In 2013, the **University of Texas-Austin** assessed the potential of offshore wind farm effects on sea-surface, subsurface, and airborne electric systems. The university surveyed electronic systems, engaged key stakeholders in industry and government to identify their possible concerns, and conducted first-principle simulations on the interactions of electromagnetic signals. The stakeholder survey confirmed that mitigation processes are in place to address interference of land-based wind farms on critical land-based radar systems in weather, air traffic control, and long-range surveillance. To date, no comprehensive study of the potential for electromagnetic interference has taken place in the United States for offshore wind farms. All of this project's findings were released in a final report, which can be accessed at wind.energy.gov/pdfs/assessment_offshore_wind_effects_on_electronic_systems.pdf.
- In 2012, **Kansas State University (KSU)** investigated the impacts of wind power development on the demography, movements, and population genetics of greater prairie chickens at three sites in north central and eastern Kansas for a seven-year time period. KSU addressed seven potential impacts of wind power development on prairie chickens: lek attendance, mating behavior, use of breeding habitat, fecundity rates, natal dispersal, survival rates, and population numbers. Results from the investigation show that greater prairie chickens were not strongly affected by wind power development in Kansas. All of this project's findings were released in a final report, which can be accessed at wind.energy.gov/pdfs/wind_power_prairie_chickens.pdf.
- **Stantec Consulting Services** actively collected data from numerous bat echolocation detector systems deployed in 2012 at locations in the Gulf of Maine, Mid-Atlantic coastal areas, and the Great Lakes. This project seeks to help offshore wind developers and regulators understand potential effects of offshore wind farms on bats by assessing how widespread bat occurrence is offshore. By the end of the project, the team aims to obtain regional and multiyear data on seasonal offshore bird and bat activities and to refine equipment, methods, and logistics to aid in the development of a remote offshore bird and bat migration data collection and monitoring system.

- From 2012 to 2014, the BioDiversity Research Institute conducted high-definition aerial and boat-based surveys of the Mid-Atlantic. Data from this project will be used to model wildlife densities and movements across temporal and spatial scales on the Mid-Atlantic continental shelf which will inform responsible and expedited siting of offshore wind projects in this region in conjunction with the "Smart from the Start" Wind Energy Areas designated by the Bureau of Ocean Energy Management.

For more information, including updates and results from national laboratory research not detailed in this report, see energy.gov/eere/wind/environmental-impacts-and-siting-wind-projects.

End Notes

[1] Energy Information Administration, U.S. Census Regions and Divisions. June 14, 2000. http://www.eia.gov/emeu/recs/census_map.html

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

eere.energy.gov
wind.energy.gov

DOE/EE-0908 • May 2015